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VACUUM THERAPY IN COMPLEX TREATMENT OF PATIENTS WITH ODONTOGENIC INFLAMMATORY PROCESS OF THE MAXILLOFACIAL AREA AND NECK

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Цель. Оценить эффективность применения вакуумной системы в комплексном лечении пациентов с одонтогенными инфекционно-воспалительными заболеваниями челюстно-лицевой области и шеи.

Материал и методы. Проведено обследование 178 пациентов с острым одонтогенным остеомиелитом челюсти, осложненным флегмоной прилежащих клетчаточных пространств. Для оказания помощи пациентам основной группы дополнительно использовалась система для вакуумной терапии ран. Пациентам группы сравнения лечение проводилось с использованием стандартных методов. Группу контроля составили 50 здоровых лиц. Деформируемость эритроцитов (ДЭ) оценивали по времени прохождения их суспензии стандартного расстояния по пористому фильтру. Адгезию лейкоцитарно-тромбоцитарной суспензии (ЛТС) исследовали, регистрируя изменения светопропускания суспензии лейкоцитов до и после инкубации вместе с волокнистым субстратом с помощью агрегометра АР 2110 «СОЛАР».

Результаты. При включении в лечебный комплекс вакуумной терапии в более короткие сроки (5 (5; 6) суток) купировалась боль при пальпации очага воспаления, на 7-е (5; 8) сутки восстанавливалась конфигурация лица, гиперемия кожи купировалась на 5-е (5; 6) сутки, гнойная экссудация из раны прекращалась на 6-е (5;7) сутки, создавались благоприятные условия для начала формирования грануляций на 7-е (6; 8) сутки. Выявлено снижение продолжительности лечения (9 (8; 10) суток) основной группы пациентов относительно пациентов группы сравнения – 10 (8; 12) суток. Вакуумная терапия при завершении лечения способствует снижению повышенных в начале лечения показателей микроциркуляции до уровня здоровых лиц.

Заключение. Применение вакуумной терапии в лечении пациентов с острым одонтогенным остеомиелитом челюсти, осложненным флегмоной прилежащих клетчаточных пространств, способствует сокращению сроков заживления раны и уменьшению продолжительности лечения с 10 (8; 12) до 9 (8; 10) суток. Выявлена нормализация скорости и степени агрегации ЛТС, ДЭ в плазме крови при завершении лечения пациентов с использованием отрицательного давления.

Ключевые слова: вакуумная терапия, инфекционно-воспалительные заболевания, челюстно-лицевая область, очищение раны, микроциркуляция

Objective. To evaluate the effectiveness of the vacuum system in the complex treatment of patients with odontogenic inflammatory diseases of the maxillofacial area and neck.

Methods. The examination of 178 patients with acute odontogenic osteomyelitis of the jaw, complicated by phlegmon of the adjacent tissue spaces, was conducted. To manage the patients of the main group vacuum system was additionally used. Patients in the comparison group were treated using standard methods. The control group consisted of 50 healthy individuals. The erythrocyte deformability (ED) was evaluated by the time of their suspension passing of a standard distance through a porous filter. The adhesion of leukocyte-platelet suspension (LTS) was investigated by recording the changes in the light transmission of the leukocyte's suspension before and after incubation with a fibrous substrate using the AR 2110 «SOLAR» aggregometer.

Results. When vacuum therapy was included in the medical complex, in shorter terms (5 (5-6) days) the pain during palpation of the inflammatory focus was stopped; the face configuration was restored on the 7 (5-8) day; the skin redness was stopped on the 5 (5-6) day; purulent exudation from the wound was stopped on the 6 (5-7) day; favorable conditions were created for the beginning of the formation of granulations on the 7 (6-8) day. A decrease in treatment terms (9 (8-10) days) of the main group of patients in relation to the duration of treatment in patients with standard complex treatment (10 (8-12) days) was revealed. Vacuum therapy at the end of treatment helps to reduce microcirculation indices elevated at the beginning of treatment to the level of healthy individuals.

Conclusions. The use of vacuum therapy in the treatment of patients with acute odontogenic osteomyelitis of the jaw, complicated by phlegmon of the adjacent tissue spaces, reduces the wound healing terms and reduces the duration of treatment from 10 (8; 12) days to 9 (8; 10) days. Normalization of the rate and degree of aggregation of LTS, DE in the blood plasma was revealed at the end of patients' treatment using negative pressure.

Keywords: vacuum therapy, inflammatory diseases, maxillofacial area, wound cleansing, microcirculation

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Vacuum Therapy in Complex Treatment of Patients with Odontogenic Inflammatory Process of the Maxillofacial Area and Neck
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Научная новизна статьи
Впервые доказано положительное влияние вакуумной терапии на такие показатели микроциркуляции, как деформируемость эритроцитов и агрегация лейкоцитарно-тромбоцитарной суспензии у пациентов с острым одонтогенным остеомиелитом челюсти, осложненным флегмоной прилежащих клетчаточных пространств; установлено, что использование вакуумной системы приводит к сокращению сроков очищения гнойной раны челюстно-лицевой области и продолжительности лечения пациентов данной категории.

What this paper adds
The positive effect of vacuum therapy on microcirculation indicators such as erythrocyte deformability and leukocyte-platelet suspension aggregation in patients with acute odontogenic osteomyelitis of the jaw, complicated by phlegmon of adjacent cellular tissue spaces, has been proved for the first time; the use of a vacuum system has been found out to lead to the reduction in purification terms of purulent wounds of the maxillofacial region and to the decrease of treatment terms of this category patients.

Introduction

For a dentist-surgeon and maxillofacial surgeon, the choice of an effective treatment tactic for odontogenic infectious-inflammatory processes (IIP) of the maxillofacial area and neck is not an easy task. Despite the development of diagnostic and prognostic methods, a high prevalence of inflammatory diseases among dental patients remains. The need to provide timely quality care to patients with odontogenic IIP is justified by the possibility of severe complications.

Issues of treatment of IIP in the maxillofacial area have been actively studied throughout the entire period of medicine development. Nowadays, there is no doubt that the treatment of odontogenic inflammatory diseases should be complex and etiopathogenetically justified. The phase of the wound process, severity of the disease, local manifestations of the inflammatory process, endogenous intoxication of the body and the type of pathogen should be taken into account when prescribing a comprehensive treatment [1]. At the same time, the main treatment of odontogenic infection is directed to the whole body as a whole (systemic therapy) and inflammation in the maxillofacial area (local therapy) and includes surgical and medication methods. Today, new effective means of systemic and local effects on the patient's body with odontogenic infectious and inflammatory diseases of the maxillofacial area and neck are being developed, which is associated with a change in the sensitivity of pathogens to environmental factors, as well as the change in the reactivity of the microorganism in the conditions of contemporary human life. In order to increase the effectiveness of local therapy of purulent wounds, vacuum systems are used in surgery, which make it possible to speed up the patients' recovery terms by creating negative pressure.

One of the first works devoted to the use of negative pressure in the maxillofacial surgery was published in 2006 [2, 3], they showed its positive effect in the treatment of traumatic injuries, infected wounds. Palm et al in 2011 noted that studies of the effects of vacuum therapy on the pathological processes of the maxillofacial area and neck were limited to reports of clinical cases or a series of cases, while negative pressure was most often used as an additional impact in the reconstructive surgery [4].

In 2015, E.S. Satteson et al demonstrated positive results of treatment with the use of vacuum therapy in 69 patients with the head and neck wounds resulting from the removal of a malignant tumor (86%), injury (8%), infections (3%), burn (3%) [5].

At this stage of treatment with negative pressure, the mechanisms of realization of the positive effect of vacuum therapy on the course of the wound process are being actively studied. Negative pressure has been proven to increase fibronectin content by regulating the activity of matrix metalloproteinase-2 and matrix metalloproteinase-9 in a wound. Prolonged local negative pressure stimulates microangiogenesis, phagocytosis and other protective mechanisms by increasing blood circulation locally [6]. However, today only a few works are devoted to the study of the effect of negative pressure on the microcirculation [7]. At the same time, the role of microcirculatory disorders in the development of infectious-inflammatory pathology has been proven [8]. There is no information about the effect of vacuum therapy of a purulent wound of the maxillofacial area on the microcirculation indices.

Objective. To evaluate the effectiveness of the vacuum system in the complex treatment of patients with odontogenic inflammatory diseases of the maxillofacial area and neck.

Methods

A comprehensive survey of 178 patients with infectious and inflammatory processes of the maxillofacial area, who underwent in-patient treatment in the department of maxillofacial surgery of Vitebsk Regional Clinical Hospital in the period from 2010 to 2018 was conducted. The criteria for the inclusion of patients in the study were:

diagnosis – acute odontogenic osteomyelitis of the jaw, complicated by phlegmon of the adjacent tissue spaces; the age over 18 years; availability of voluntary informed consent to participate in the study. The exclusion criteria were: the age less than 18 years; pregnancy; concomitant diseases in the acute stage; presence of a history of alcohol abuse and drug use; lack of voluntary informed consent. A controlled post-registration clinical trial with a historical type of control (historical control) was performed.

The observed patients were divided into groups: the main group – 20 people, the comparison group – 158 people. The control group consisted of 50 healthy individuals. The compared groups were comparable by sex and age, the patients of the main group and the comparison group did not have statistically significant differences in the localization of the process, the prescribed antibacterial therapy, the initial data of laboratory studies.

The treatment of the patients was complex and included surgical and medication methods. To manage the patients of the main group, the system for vacuum therapy of wounds was additionally used, including porous material with a pore diameter of 400–1,200 micrometers, a non-falling tube, a surgical antimicrobial cut surface, and a vacuum source. Vacuum therapy was started from 2-3 days after the surgery for a period of 3-4 days, depending on the clinical situation, before cleansing the wound from necrotic masses. To do this, the operative field was treated with antiseptics, an irrigation tube was placed on the bottom of the wound, the wound was covered with porous material and sealed with a surgical-cut coating, the drainage tube was connected to a vacuum source at which the negative pressure level was set to 125 mmHg, through a tube for irrigation, the wound was washed with antiseptics [9].

Clinical evaluation of the treatment was carried out on the basis of the state of the purulent wound, which was determined daily during the dressings: the day was fixed, during which the patient noted no pain during palpation of the inflammatory focus, the day on which the face configuration was restored, the hyperemia of the wounds in the wound area was stopped, purulent exudation stopped and the day on which the growth of granulation tissue was visually determined in the wound. The duration of patient's treatment and the duration of antibiotic therapy (ABT) were also evaluated. Blood sampling for the study of microcirculation (MC) parameters — erythrocyte deformability (ED) and leukocyte-platelet suspension (LPS) aggregation—was made from the ulnar vein of patients on an empty stomach twice: during the patient's initial admission to the hospital (sample 1) and upon completion of treatment (sample 2). ED was evaluated by the time of their suspension passing of a standard distance through a porous filter. 0.1% adrenaline solution (final concentration 1.0 mg/L) was used as an inducer of LPS aggregation. Leukocyte adhesion was investigated by recording changes in the light transmission of the leukocyte suspension before and after incubation together with a fibrous substrate using the AP 2110 SOLAR aggregometer [10].

Statistics

Statistical processing of the data was carried out using the package of applied tables "Statistica" (Version 10-Index, license No. STA9999K347156W, StatSoft Inc., USA) and Excel. When distributing of a trait other than normal, the median (Me), the lower 25th (LQ) and the upper 75th quartile (UQ) were calculated. To assess statistical significance between unrelated groups, the Mann-Whitney test (U) was used. In a multiple comparison of independent groups, the Kruskal-Wallis test was used. The critical level of p significance when testing statistical hypotheses in the study was assumed to be 0.05.

Results

Clinical indicators of patients with the jaw osteomyelitis, complicated by phlegmon, who received the standard treatment complex – the comparison group and patients with jaw osteomyelitis, complicated by phlegmon, in whose medical complex vacuum therapy was included, the main group, are presented in Table 1.

The course of the wound process when vacuum therapy was included in the medical complex was characterized by positive differences from the control indices ($p<0.05$): in a shorter period (5 (5; 6) days), the pain was arrested when palpating the inflammatory focus, on the 7 (5; 8) day, the configuration of the face was restored, skin hyperemia was stopped on the 5 (5; 6) day, purulent exudation from the wound was stopped on the 6 (5; 7) days, favorable conditions were created for the start of granulation formation on the 7 (6; 8) day.

Also, in the group of patients with the jaw osteomyelitis, complicated by phlegmon, in the medical complex in which vacuum therapy was included, a decrease in treatment terms (9 (8; 10) days) was found in relation to the terms of treatment in patients with standard complex treatment - 10 (8; 12) days. The reduction in the duration of ABT was statistically significant in relation to the indicator of patients with standard complex treatment, respectively: 8 (7; 9) days and 9 (7; 11) days, $p=0.04$.

Table 1

Clinical indicators of patients with the jaw osteomyelitis, complicated by phlegmon, who received the standard treatment complex and patients with jaw osteomyelitis, complicated by phlegmon, in whose medical complex vacuum therapy was included (Me (LQ;UQ))

Indicator	Main group	Comparison group	p
Arresting of the pain (day)	5 (5; 6)	8 (7; 9)	0.00001
Restoring the face configuration, day	7 (5; 8)	9 (7; 10)	0.001
Absence of hyperemia, day	5 (5; 6)	7 (5; 9)	0.01
Absence of purulent exudation, day	6 (5; 7)	7 (5; 9)	0.04
Determination of granulations growth, day	7 (6; 8)	8 (6; 10)	0.04

Indicators of microcirculation of patients with the jaw osteomyelitis, complicated by phlegmon, in the medical complex of which vacuum therapy was included, on the day of hospitalization were: LPS aggregation rate – 15.3 (10.2; 27)%/min, LPS aggregation degree – 45.5 (27.8; 48, 4)%, ED in plasma – 36.5 (25.5; 41.2) s, ED in saline - 17.4 (12.6; 20.4) s, which did not have statistically significant differences from indicators of patients with standard complex treatment ($p>0.05$). At the same time, at the end of treatment, such indicators as the rate and degree of aggregation of LPS, the duration of ED in the blood plasma were lower ($p<0.05$) in patients whose treatment included vacuum therapy; it is presented in Table 2.

A statistical analysis of the MC parameters in patients of two compared groups with the data of healthy individuals was performed: the aggregation rate of LPS – 7 (1.2; 18.6)%/min; the degree of aggregation of LPS – 16.8 (4.8; 29.4)%, ED in plasma – 27.9 (25.5; 32.6) s, ED in saline – 15.2 (13.1; 17.3) s. In patients of the main group and the comparison group, on admission to the hospital, an increase in the rate and degree of aggregation of LPS was detected, as well as an increase in the duration of ED in the blood plasma ($p <0.05$). When finishing the treatment of patients with the jaw osteomyelitis, complicated by phlegmon, in whose treatment vacuum therapy was applied, unlike patients with the standard complex treatment, the studied MC indicators had no statistically significant differences ($p>0.05$) from those of healthy individuals.

Discussions

The results of the presented study demonstrate terms reduction of cleansing and healing of the purulent wounds of the maxillofacial region; it is consistent with the data of modern authors. In the work of Razmahnin E.V. et al. (2015), the positive effect of vacuum therapy on the course of the wound process and the acceleration of wound healing is demonstrated. It has been revealed that the use of negative pressure leads to a decrease in edema, increased local blood circulation, a decrease in the level of microbial contamination of the wound, a decrease in the volume and area of the wound. Vacuum therapy contributes to maintain a moist wound environment and reduces purulent exudation. The combination of these effects leads to an intensification of cell proliferation, increased synthesis in the wound structural components of the connective tissue [11]. V.A. Monakov et al. [12] found that the duration of the phases of the wound process due to the use of vacuum therapy also changes positively in comparison with the indicators of patients with standard treatment. At the same time, starting from the third day of negative pressure application, the authors identified a macrophage reaction in smears imprints from the surface of the wound, which indicates the effectiveness of the treatment. At the same time, there was an increase in the regeneration processes in the wound, and with standard treatment – only by the fifth and seventh days from the therapy

Table 2

Indicators of microcirculation of patients of patients with the jaw osteomyelitis, complicated by phlegmon, who received the standard treatment complex and patients with jaw osteomyelitis, complicated by phlegmon, in whose medical complex vacuum therapy was included Me (Me (LQ;UQ))

Test	Indicator	Main group	Comparison group	p
1	Aggregation rate of LPS,%/min	15.3 (10.2; 27)	15.8 (9.2; 25.1)	>0.05
	Aggregation degree of LPS,%	45.5 (27.8; 48.4)	27.4 (18.9;50.7)	
	ED in the blood plasma, s	36.5 (25.5; 41.2)	34.2 (31.1; 38.3)	
	ED in saline, s	17.4 (12.6; 20.4)	14.2 (12.1; 17)	
2	Aggregation rate of LPS,%/min	8.8 (7.2; 13.2)	14.6 (9.7; 21.7)	0.01
	Aggregation degree of LPS,%	16.4 (11.2; 25.7)	26.7 (16; 43.1)	0.03
	ED in the blood plasma, s	24.8 (21.3; 34.73)	33.7 (27.4; 45.5)	0.005
	ED in saline, s	12.9 (11.9; 20.6)	14.5 (12.5; 16.3)	>0.05

start. With the help of computer monitoring, V.P. Zemlyanoy [7] determined the characteristics of a purulent wound when including in the complex treatment of vacuum therapy: the area of the wound, the volume of necrotic tissue, the growth of granulations and epithelialization. A significant decrease in the severity of necrosis was revealed in relation to the comparison group on the 10th and 15th day of treatment as well as the intensification of the granulations formation on the 5th day of treatment. The improvement in the microcirculation index in patients after the application of negative pressure in the area of purulent wounds was proved.

It should be noted that the study of indicators of LPS aggregation and ED using vacuum therapy of purulent wounds of the maxillofacial area, the results of which are reflected in the presented study, has not been previously conducted. For the first time it has been revealed that the inclusion of vacuum therapy in the scheme of complex treatment in patients with the jaw osteomyelitis, complicated by phlegmon leads to the decrease of the initially elevated MC parameters up to the normal level. The data obtained can be explained by the positive effect of negative pressure on the rheological properties of blood, local blood flow, tissue metabolism of the maxillofacial region as a whole. In vitro studies it has been shown that negative pressure promotes angiogenesis, migration and proliferation of endothelial cells [13]. The production of migratory and proliferative endotheliocytes increases in the case of intermittent negative pressure; negative pressure does not affect the function of skin fibroblasts [14]. In the experiment, performed by Terskov D.V. et al in 2016, the acceleration of the granulation tissue formation in a wound in the case of the use of vacuum therapy was proven. In the study of the effects of various modes of negative pressure on the wound, it was found out that alternating the cycles of rest and vacuum contributes to tissue elasticity improvement as well as to the production of vascular endothelial growth factors (VEGF) and fibroblasts (FGF-2) [15].

The data presented by modern researchers and the results obtained in the present study indicate the positive effect of vacuum therapy on the processes of cleansing and healing of purulent wounds, as well as on the microcirculation indices of patients with infectious and inflammatory diseases of the maxillofacial area and neck.

Conclusions

The use of vacuum therapy in the treatment of patients with the jaw acute odontogenic osteomyelitis, complicated by phlegmon of the adjacent tissue spaces, contributes to the reduction of wound healing terms and to decrease of treatment terms from 10 (8; 12) days to 9 (8; 10) days. The normalization of microcirculation indices was revealed (the rate and degree of aggregation of LPS, ED in the blood plasma) when finishing the treatment of patients using negative pressure, while in patients with standard treatment there were still deviations from the values of healthy individuals. The data obtained give grounds to recommend the use of the vacuum system in the complex treatment of patients with odontogenic inflammatory diseases of the maxillofacial area and neck, which will increase the efficiency of medical care for this category of patients.

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Conflict of interest

The author declares that there is no conflict of interest.

Ethical aspects

The work was approved by the Committee on the Ethics of Vitebsk State Medical University.

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